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RCRA CORRECTIVE MEASURES PROPOSAL REPORT SOLID WASTE MANAGEMENT UNIT 8 (SWMU 8) LOAD AND FILL AREA BUILDING 106 POND NSA CRANE IN

6/1/2008

TETRA TECH

224

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-04-D-0055

Rev. 0
06/08

Resource Conservation and Recovery Act Corrective Measures Proposal Report for SWMU 8 – Load and Fill Area, Building 106 Pond

Naval Surface Warfare Center Crane, Indiana

Contract Task Order 21

June 2008

NAVFAC
Naval Facilities Engineering Command
Midwest
201 Decatur Avenue
Building 1A, Code EV
Great Lakes, Illinois 60088

TETRA TECH NUS, Inc.

RESOURCE CONSERVATION AND RECOVERY ACT
CORRECTIVE MEASURES PROPOSAL REPORT
FOR
SWMU 8 – LOAD AND FILL AREA, BUILDING 106 POND

NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Midwest
201 Decatur Avenue
Building IA, Code EV
Great Lakes, Illinois 60088

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CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 21

JUNE 2008

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ACRONYMS

µg/L	Microgram per liter
bgs	Below ground surface
BRAC	Base Realignment and Closure
CAAA	Crane Army Ammunition Activity
CLEAN	Comprehensive Long-Term Environmental Action Navy
CM	Corrective measure
CMP	Corrective Measures Proposal
COC	Chemical of concern
COPC	Chemical of potential concern
CTO	Contract Task Order
HHRA	Human health risk assessment
HI	Hazard index
IAS	Initial Assessment Study
IDEM	Indiana Department of Environmental Management
IR	Installation Restoration
LUC	Land use control
MCL	Maximum Contaminant Level
MCS	Media cleanup standard
msl	Mean sea level
NAD	Naval Ammunition Depot
NAVFAC	Naval Facilities Engineering Command
NPW	Net Present Worth
NSWC	Naval Surface Warfare Center
PA	Preliminary Assessment
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
Plz	Lower Pennsylvanian water-bearing zone
Pmz	Middle Pennsylvanian water-bearing zone
Puz	Upper Pennsylvanian and overburden water-bearing zone
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation

SVOC	Semivolatile organic compound
SWMU	Solid Waste Management Unit
TCE	Trichloroethene
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound

1.0 INTRODUCTION

1.1 SCOPE AND OBJECTIVES

This Resource Conservation and Recovery Act (RCRA) Corrective Measures Proposal (CMP) Report was prepared for the Load and Fill Area, Building 106 Pond at the Naval Surface Warfare Center (NSWC) Crane facility located in Crane, Indiana, for the Naval Facilities Engineering Command (NAVFAC), Midwest under Contract Task Order (CTO) 0021 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) IV Contract Number N62467-04-D-0055. The Load and Fill Area, Building 106 Pond is also known as Solid Waste Management Unit (SWMU) 8.

This CMP Report is part of the Navy Installation Restoration (IR) Program, which is designed to identify contamination from past operations at Navy and Marine Corps lands and facilities and to institute corrective measures (CMs), as needed. There are typically four distinct phases of work conducted for IR sites. Phase 1 is the Preliminary Assessment (PA) [formerly known as the Initial Assessment Study (IAS)]. Phase 2 is a RCRA Facility Assessment (RFA), which augments the information collected in the PA. Phase 3 is the RCRA Facility Investigation (RFI)/CMP, which characterizes the contamination at a facility and develops options for remedies at the site. Phase 4 is the CMs Implementation, which results in the control or cleanup of contamination at the site. This CMP Report was prepared under Phase 3 after completion of the RFI. The Indiana Department of Environmental Management (IDEM) is the lead oversight agency for SWMU 8.

This CMP Report was prepared in accordance with the requirements of the Indiana State RCRA Hazardous Waste Permit for the facility (IN5170023498), which went into effect on October 18, 2001.

The objectives of the CMP for SWMU 8 are as follows:

- Identify risk-based action levels for chemicals of concern (COCs) that are protective of human receptors and the environment.
- Develop CMs to protect human receptors and the environment.

1.2 PURPOSE OF THE CORRECTIVE MEASURES PROPOSAL

The purpose of the CMP is to present supporting documentation for the CMs proposed to remediate releases associated with environmental concerns at SWMU 8. Supporting documentation includes data and information that have been gathered during the RFA, RFI, and interim remedial action for Building 106 pond water and sediment (i.e., source removal).

The submittal of a CMP instead of a Corrective Measures Study is appropriate for SWMU 8 based on the following:

- NSWC Crane is a fenced military installation controlled by the Navy.
- NSWC Crane was not included in the 2005 Base Realignment and Closure (BRAC) process and will remain a military installation for the indefinite future.
- Anticipated land uses are military (i.e., industrial).
- Residential land use occurs only in very limited areas of the facility, none of which are located within or adjacent to SWMU 8.
- Unique topography, geology, and hydrogeology prevent future groundwater contaminant migration from SWMU 8.

1.3 ORGANIZATION OF CORRECTIVE MEASURES PROPOSAL

This CMP consists of four sections. Section 1.0 is this introduction. Section 2.0 provides a description of previous investigations and presents the media cleanup standards (MCSs) for SWMU 8. Section 3.0 describes the CMs recommendations. Section 4.0 provides the details of the CMs recommendations.

1.4 FACILITY BACKGROUND INFORMATION

1.4.1 Facility Location

NSWC Crane is located in the southern portion of Indiana, approximately 75 miles southwest of Indianapolis and 71 miles north of Louisville, Kentucky, immediately east of Crane Village and Burns City (Figure 1-1).

NSWC Crane encompasses 62,463 acres (approximately 98 square miles), most of which is located in the northern portion of Martin County. Smaller portions are located in Greene, Daviess, and Lawrence

Counties. NSWC Crane is located in a rural, sparsely populated area. Most of NSWC Crane is forested, and the surrounding area is wooded or farmed land.

NSWC Crane provides Naval support for equipment, shipboard weapons systems, and ordnance. In addition, NSWC Crane supports the Crane Army Ammunition Activity (CAAA) with production, renovation, storage, shipment, demilitarization, and disposal of conventional ammunition.

1.4.2 Facility History

This section provides general information on the history of NSWC Crane and its activities.

1.4.2.1 History of Ownership and Operation

In 1940, Congress authorized construction of a Naval Ammunition Depot (NAD) in southern Indiana. NAD Burns City was commissioned in late 1941. In 1943, NAD Burns City was renamed NAD Crane, and the Town of Crane was built to house the rapidly growing number of civil service employees. The overall mission of NAD Crane was to load, prepare, renovate, receive, store, and issue ammunition to the fleet.

During World War II, the mission of NAD Crane was expanded to include pyrotechnics production, mine filling, rocket assembly, field storage, torpedo storage, and ordnance spare parts and mobile equipment storage. During the 1950s, several new departments were created. The Ammunition Loading and Production Engineering Center was transferred to NAD Crane, and the Central Ammunition Supply Control Office was established. NAD Crane supplied ammunition to the fleet during the Korean and Vietnam Conflicts. During the Vietnam Conflict, the number of full-time employees at NAD Crane increased to 6,800.

In 1975, NAD Crane was redesignated Naval Weapons Support Center Crane. Its new mission was to provide support for ships, aircraft, equipment, shipboard weapons systems, and assigned ordnance items and to perform additional functions as directed.

In 1977, the Single Manager Concept was implemented, the CAAA was created, and the Army assumed ordnance production, storage, and related responsibilities as a tenant organization. Other functions remained under Navy control. In 1992, the facility was redesignated as NSWC Crane. The Navy currently retains ownership of all real estate and facilities at NSWC Crane. Responsibility for overall station safety, security, and environmental protection remains with the Commanding Officer, NSWC Crane. Approximately 3,600 people are currently employed at NSWC Crane.

1.4.2.2 History of Regulatory Actions

Following promulgation of the USEPA RCRA hazardous waste regulatory program, NSWC Crane filed notification and application to operate as a RCRA hazardous waste treatment, storage, or disposal facility in October 1980. Interim status was granted subject to the operating requirements and applicable technical standards in Title 40 of the Code of Federal Regulations, Part 265.

Corrective action programs established as part of the 1984 RCRA Hazardous and Solid Waste Amendments required NSWC Crane to address past releases of hazardous waste or hazardous constituents at SWMUs. Accordingly, NSWC Crane submitted a Hazardous Waste Management Report, and an RFA was conducted to characterize the potential for releases of hazardous waste or constituents from approximately 100 SWMUs identified during the RFA.

On December 23, 1989, USEPA issued the federal portion of the Final RCRA Part B permit for NSWC Crane to the Navy. USEPA renewed the permit in 1995. IDEM now has responsibility for the federal Corrective Action Program. IDEM renewed the Corrective Action Permit on October 18, 2001. However, certain ongoing corrective actions, including corrective actions at SWMU 8, will continue under the USEPA/IDEM Work Sharing Agreement for Corrective Action Activities at the NSWC – Crane Division.

1.5 SWMU 8 BACKGROUND INFORMATION

This section provides a summary of background information for SWMU 8. Additional details are provided in the RFI Report (TtNUS, 2007).

1.5.1 Site Description

The Building 106 Pond is located in the Load and Fill Area, which occupies 5.8 acres near the western boundary of NSWC Crane, approximately midway between the northern and southern boundaries of the facility (Figure 1-1). The pond covers an area of approximately 2,550 square feet (0.06 acre) and is surrounded by trees and a fence. The area east and northeast of the pond is wooded, and there is an open grassy area south of the pond. Buildings 106 and 107 and several other buildings are located west and northwest of the pond, and a former Industrial Wastewater Treatment Facility (Building 2961) was located south of the pond. A deep drainage channel (Tributary 8-03) is located north and east of the pond. Site features are shown on Figure 1-2.

1.5.2 Site History

Buildings 106 and 107 have historically been involved with the overhaul of projectile casings. Building 106 housed a cleaning process consisting of a caustic wash, trichloroethene (TCE) degreasing unit, and hydrochloric acid wash.

In the mid-1970s, Building 106 was used to apply a zinc phosphate coating to projectiles. The process also used a dilute solution of either chromic acid or chromic and phosphoric acids.

Paint booths in Buildings 106 and 107 were used to apply coatings to missile containers. Zinc chromate coating containing 40 percent toluene was applied in one of the paint booths, and an olive drab coating containing 22 percent naphtha was applied in the other paint booth. Each paint booth used approximately 500 gallons of coating material per year. Prior to coating, the missile containers were sandblasted with silica, which produced approximately 800 to 1,000 ponds of baghouse residue per day.

Building 107 was also used to refinish metal and wooden boxes. Metal boxes were cleaned with TCE and painted in paint booths equipped with water washes to control particulates. Approximately 700 gallons of TCE was used per year, and 300 to 400 pounds of dust were collected daily from the baghouse. An additional treatment step was used for wooden boxes that consisted of dipping the boxes in a 5-percent solution of pentachlorophenol. Approximately 8,000 gallons of pentachlorophenol were used annually.

Prior to 1972, splash out and overflows of wastewater from Buildings 106 and 107 were discharged into a small unlined pond (Building 106 Pond) that drained into ditches. After 1972, the pond was connected to a neutralization treatment system that discharged to the sanitary sewer. Floor drains that may have contained TCE, pentachlorophenol, paint residue, and heavy metals also discharged to the pond along with oily wastewater from leaking compressors. The pond no longer receives discharges nor does it have a discharge to surface water.

Spills from drums stored in the former drum storage location south of Building 106 may also have occurred. The drums were believed to contain metals, organic solvents, fuels, pesticides, herbicides, and polychlorinated biphenyls (PCBs).

Currently, equipment repair operations are intermittently performed in Buildings 106 and 107.

Interim measures (removal actions) for the Building 106 Pond were completed during August 2007. Contaminated sediment was removed, dewatered as necessary, and shipped off site for treatment and disposal. Pond water and water from sediment dewatering were treated on site and discharged to the NSWC Crane wastewater treatment plant.

1.5.3 Topography and Surface Drainage

The topography at SWMU 8 consists of a north-south oriented ridge. The slopes across the top of the ridge are very gradual. The slope becomes steeper south and east of the Building 106 Pond. Surface water runoff drains to the periphery of the developed area where the buildings are located and runs down the steep hillside to the south and east in small ephemeral gullies (Figure 1-2). One of the gullies (Tributary 8-03) flows near the northern and eastern sides of the Building 106 Pond. The gullies flow into a large unnamed tributary (main stream) located approximately 500 feet south of Building 106. The main stream flows from west to east toward Boggs Creek.

Elevations at the top of the ridge range from approximately 670 to 700 feet above mean sea level (msl). The elevation of the large unnamed tributary is approximately 590 feet above msl. The total topographic relief around SWMU 8 is approximately 110 feet.

1.5.4 Site Geology and Soil

The top of the ridge where the buildings and pond are located is covered with residual and reworked clayey silt soils that range from 2 to 19 feet thick but are generally less than 7 feet thick. The soils are underlain by Pennsylvanian-age bedrock that consists of discontinuous layers of siltstone, sandstone, shale, and coal seams. Three geologic cross sections (A-A' to C-C') were developed to illustrate the subsurface materials underlying SWMU 8 and areas downgradient of the site. Figure 1-3 shows the locations of the generalized geologic cross sections, and the cross sections are presented on Figure 1-4.

The highest part of the SWMU 8 ridge is capped by soil, shaly sandstone, fine sandstone, and medium sandstone. Permanent monitoring wells installed in these geologic strata (08MWT002, 08MWT004, 08MWT006, 08MWT007, and 08MWT008) are Upper Pennsylvanian or overburden monitoring wells.

Beneath the uppermost overburden and sandstone, black shale containing coal streaks was generally encountered between 660 and 672 above mean sea level (msl). This shale unit was 5 to 8 feet thick in most locations but was not encountered at location 08MWT001, which is just southeast of the Building 106 Pond (cross section C-C', Figure 1-4).

Laminated siltstone, shale, and fine sandstone were generally encountered between 645 and 660 feet above msl. These units were relatively dry when drilled. On the southern and southeastern sides of the pond (08MWT001 and 08MWT003), a well-sorted, orange to pink, medium sandstone was encountered between approximately 615 and 645 above msl. This sandstone is porous and well oxidized. On the southern and southwestern side of SWMU 8 (near wells 08MWT001, 08MWT005, and 08MWT012 on cross section C-C'), the same interval is partially occupied by finer-grained sandstone and siltstone with coal streaks and a small coal seam. Permanent monitoring wells 08MWT001, 08MWT003, 08MWT005, 08MWT009, and 08MWT012 are screened in the geologic strata between 611 and 648 above msl and are Middle Pennsylvanian monitoring wells.

Between 570 and 620 feet above msl, a thick sequence of laminated, gray to tan, fine-grained sandstones, siltstones, and silty shales were encountered. In most cases, this sequence of rock was well cemented, massive, and dry. However, between 595 and 605 feet above msl, the shaly siltstone was often fractured and produced significant quantities of water when drilled. Between 560 and 570 feet above msl, fine sandstone with minor shale interbeds, coal streaks, and a very thin coal seam was encountered. The sandstone appeared to be irregularly bedded and broken in this zone. Permanent monitoring wells 08MWT010, 08MWT011, 08MWT013, and 08MWT014 are screened in this elevation range and are referred to as Lower Pennsylvanian monitoring wells.

1.5.5 Site Hydrogeology

Saturated conditions were encountered in overburden materials at several locations (08MTW002, 08MTW004, and 08MTW006). Saturated conditions were also encountered in the lower portions of the uppermost sandstone (08MTW007 and 08MWT008). These five wells represent the Upper Pennsylvanian and overburden water-bearing zone (Puz). This zone is recharged by downward infiltration through surface soil. Figure 1-5 presents the potentiometric surface map for the Puz. The primary groundwater flow direction in the area around the pond is to the east and southeast. All shallow groundwater in the Puz is presumably flowing toward and discharging to the gullies on the eastern and southern sides of the hillside (primarily Tributary 8-03) or discharging to surface soil as seeps and gradually evaporating. Much of the groundwater eventually reaches the edge of the hillside and is taken up by vegetation, discharges to the surface as seeps or springs, or continues down the slope as seepage through the thin veneer of soil that covers the hillside. Based on aquifer tests and groundwater elevations, the estimated linear groundwater velocity ranges from 2.27 to 3.01 feet per day (829 to 1,100 feet per year).

A fairly continuous black, finely laminated, clay shale exists beneath the Puz. This shale is very impervious and is expected to act as an effective aquitard that minimizes migration of groundwater to deeper strata. However, the aquitard is not continuous and appears to be breached at one or more locations. One of these locations is west of Building 106 near 08MWT008 (see cross section B-B' on Figure 1-4), and another is just southeast of the Building 106 Pond near 08MWT001 (see cross section C-C' on Figure 1-4). The aquitard could also have been breached during excavation when the pond was constructed. The rock immediately below the black shale was dry, but saturated rock was encountered at deeper depths. This deeper groundwater resides in porous, highly oxidized, medium-grained sandstone that is referred to as the Middle Pennsylvanian water-bearing zone (Pmz). The sandstone was present at 08MTW001 and 08MTW003 just south of the pond. Groundwater was also encountered in this zone at 08MTW005 and 08MTW012 farther southwest of the pond. The sandstone in this area becomes finer grained and contains coal streaks and a thin seam of coal. These four wells were used to represent the Pmz. Figure 1-6 presents the potentiometric surface map for the Pmz. Groundwater elevations mimic the surface topography and decrease toward the southeast. Groundwater in the Pmz, like the Puz, is expected to discharge to the hillside but at a lower elevation. Groundwater discharge around the hillside has been observed at seeps and along the roadside ditch southeast of 08MTW009. Groundwater in the Pmz is also expected to discharge slowly to Tributary 8-03. Based on aquifer tests and groundwater elevations, the estimated linear groundwater flow velocity in the Pmz ranges from 1.39 to 1.58 feet per day (508 to 578 feet per year).

The deepest monitoring wells are screened in laminated siltstone, sandstone, and silty shale. This rock type is not very permeable; however, fractured rock was encountered at 08MTW013 and 08MTW014. These wells and wells 08MTW010 and 08MTW011 represent the Lower Pennsylvanian water-bearing zone (Plz). Water levels measured in this zone are presented on Figure 1-7. Potentiometric contours were not developed because erratic water levels were encountered. A possible explanation for the erratic water levels is that the hydraulic conductivities in this interval are relatively low. Thus, the water levels do not react quickly to changes in hydraulic potentials around them. The hydraulic gradient in the Plz appears to be almost flat, and the hydraulic conductivity is very low (0.061 foot per day). Thus, linear groundwater velocities are assumed to be one or two orders of magnitude lower than in the Puz and Pmz.

Most of the groundwater is flowing laterally eastward, southward, and westward from the ridge. Some groundwater is likely flowing from the upper sandstone (Puz) downward to the second sandstone unit (Pmz) and subsequently down to the lowermost Pennsylvanian strata (Plz). The hydraulic heads measured in monitoring wells consistently decrease in elevation as the elevations of the well screens decrease. This indicates that recharge occurs along the upper slopes of the ridge and that groundwater flow is mostly horizontal with a small vertical downward component. The downward flow rates are very low based on the following evidence:

- Much of the upper portion of the Pmz is dry, which indicates that groundwater in the Puz is perched and cannot move down to the Pmz very quickly. The black shale and siltstone between the Puz and Pmz is expected to be an effective barrier to downward groundwater flow.

- The fact that groundwater elevations decrease dramatically from top to bottom in the ridge indicates a large vertical hydraulic gradient exists, which reflects the low permeability of shales and siltstones between the Puz, Pmz, and Plz.

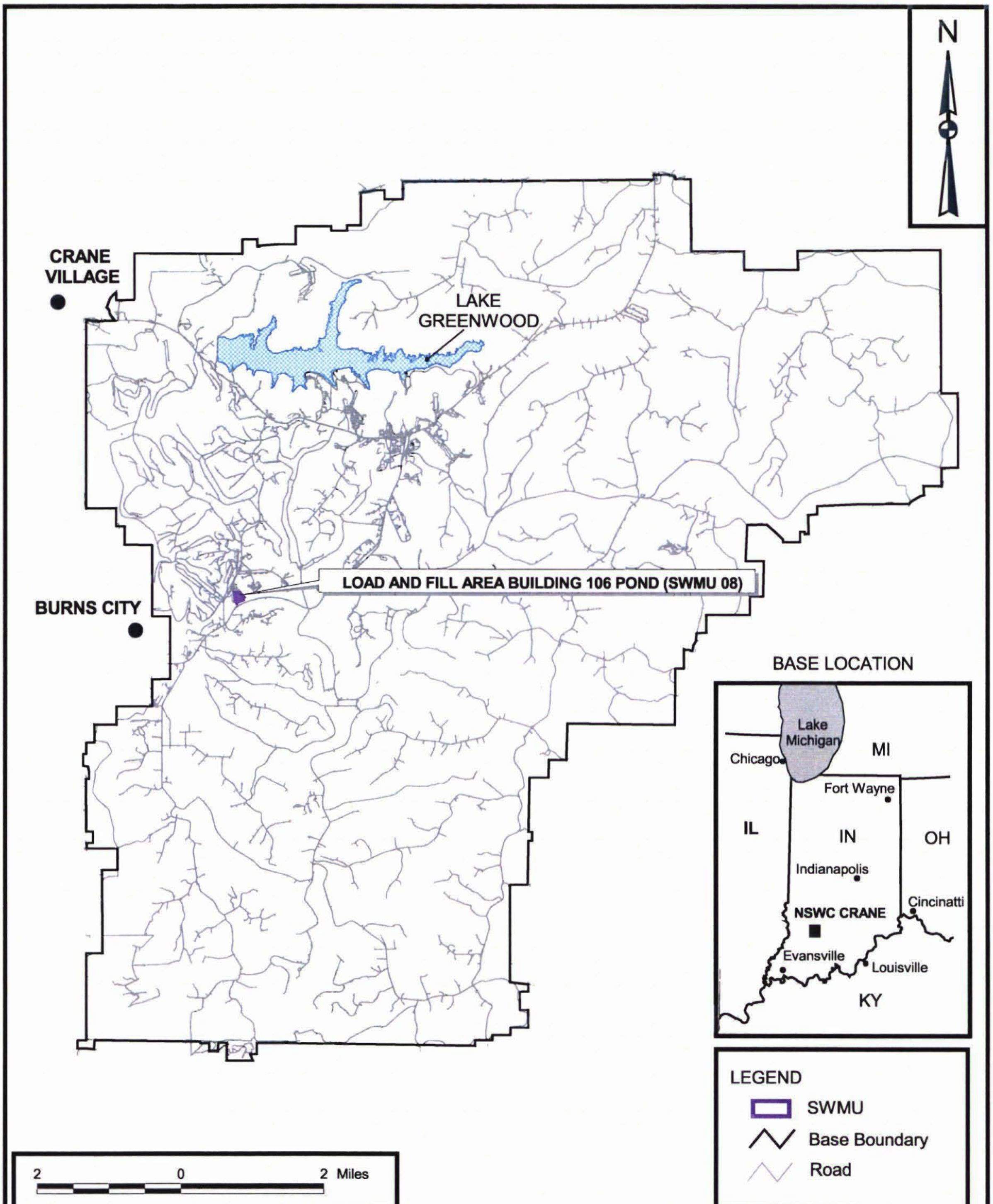
- Three different nests of wells also indicate a very large hydraulic head differential between the Puz, Pmz, and Plz. The average head difference between the wells in the Puz and the Pmz was approximately 40 feet. The same approximate decrease occurs between the Pmz and Plz.

1.5.6 Water Supply

Groundwater at SWMU 8 is not currently used and will not be used in the future. Lake Greenwood, an 800-acre man-made, spring-fed lake in the northwestern portion of the installation (Figure 1-1) is the main source of drinking water at NSWC Crane and is expected to remain as such in the future. Lake Greenwood is located more than 1.5 miles from SWMU 8.

1.5.7 Surrounding Land Use

SWMU 8 is approximately 1 mile east of the nearest NSWC Crane property boundary. There are no known current or likely future land use changes under consideration or proposed at this time for this SWMU. SWMU 8 is contained completely within NSWC Crane, and likely future land use at areas surrounding the SWMU is expected to be limited to industrial uses.



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CHECKED BY K. TURNBULL — DATE 02/01/08			APPROVED BY — DATE
COST/SCHEDULE-AREA			APPROVED BY — DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-1 — REV 0

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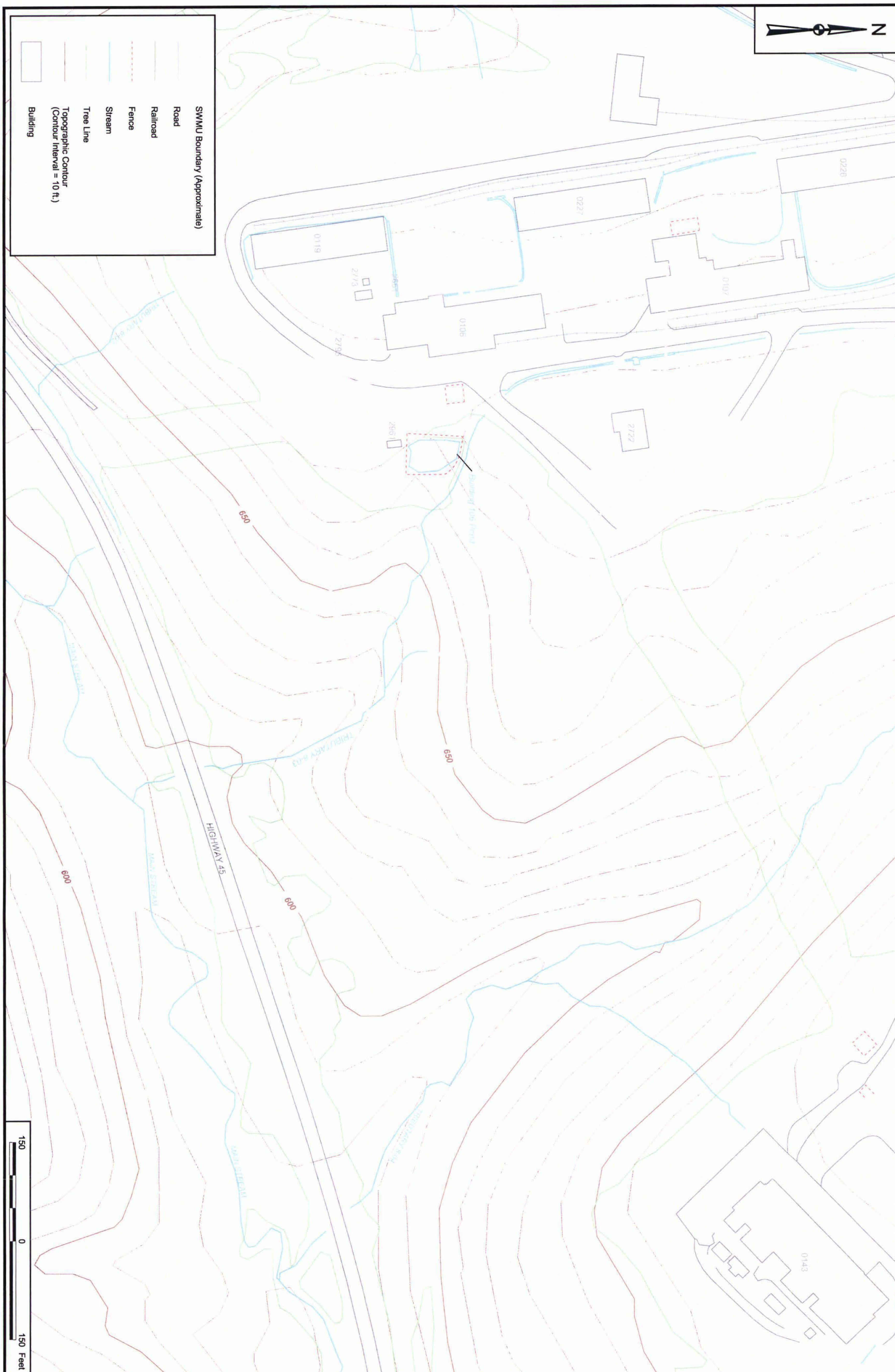

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K. PEILA	10/19/05
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K. TURNBULL	02/21/08
COST/SCHED-AREA	
SCALE	
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NAVFAC

SITE FEATURES
SWMU 8 - BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

CONTRACT NO.
CTO 0021

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO.
FIGURE 1 - 2

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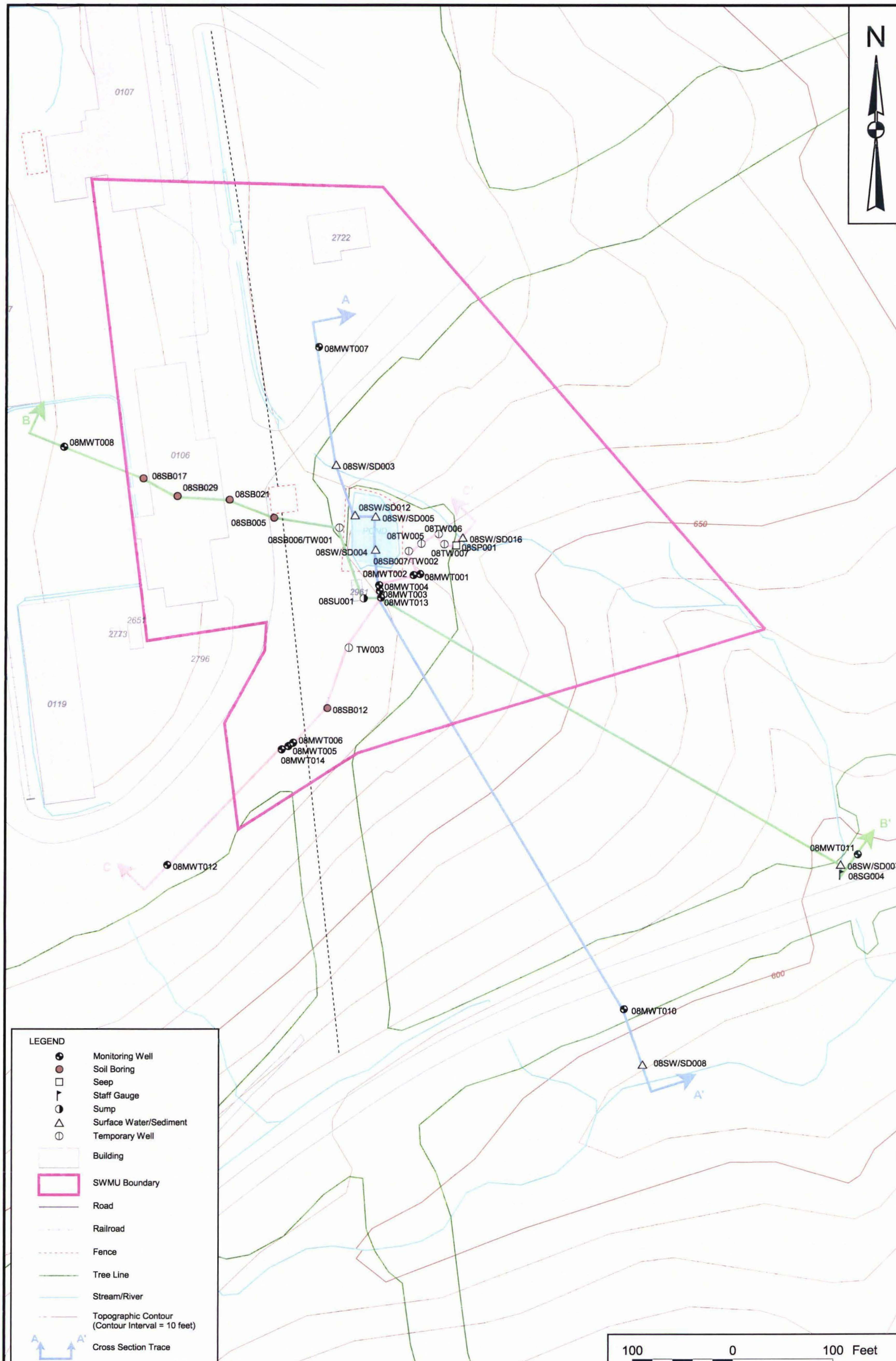

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COST/SCHEDULE-AREA			APPROVED BY — DATE —
SCALE: AS NOTED			DRAWING NO.: FIGURE 1 - 3 — REV: 0

DRAWN BY MF | DATE 2/3/06
CHECKED BY | DATE
REVISED BY | DATE
SCALE AS NOTED

Tetra Tech NUS, Inc.

GEOLOGIC CROSS SECTIONS A-A', B-B', & C-C'
SWMU 8 - BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

CONTRACT NO. CTO 0021
OWNER NO. 0000
APPROVED BY | DATE
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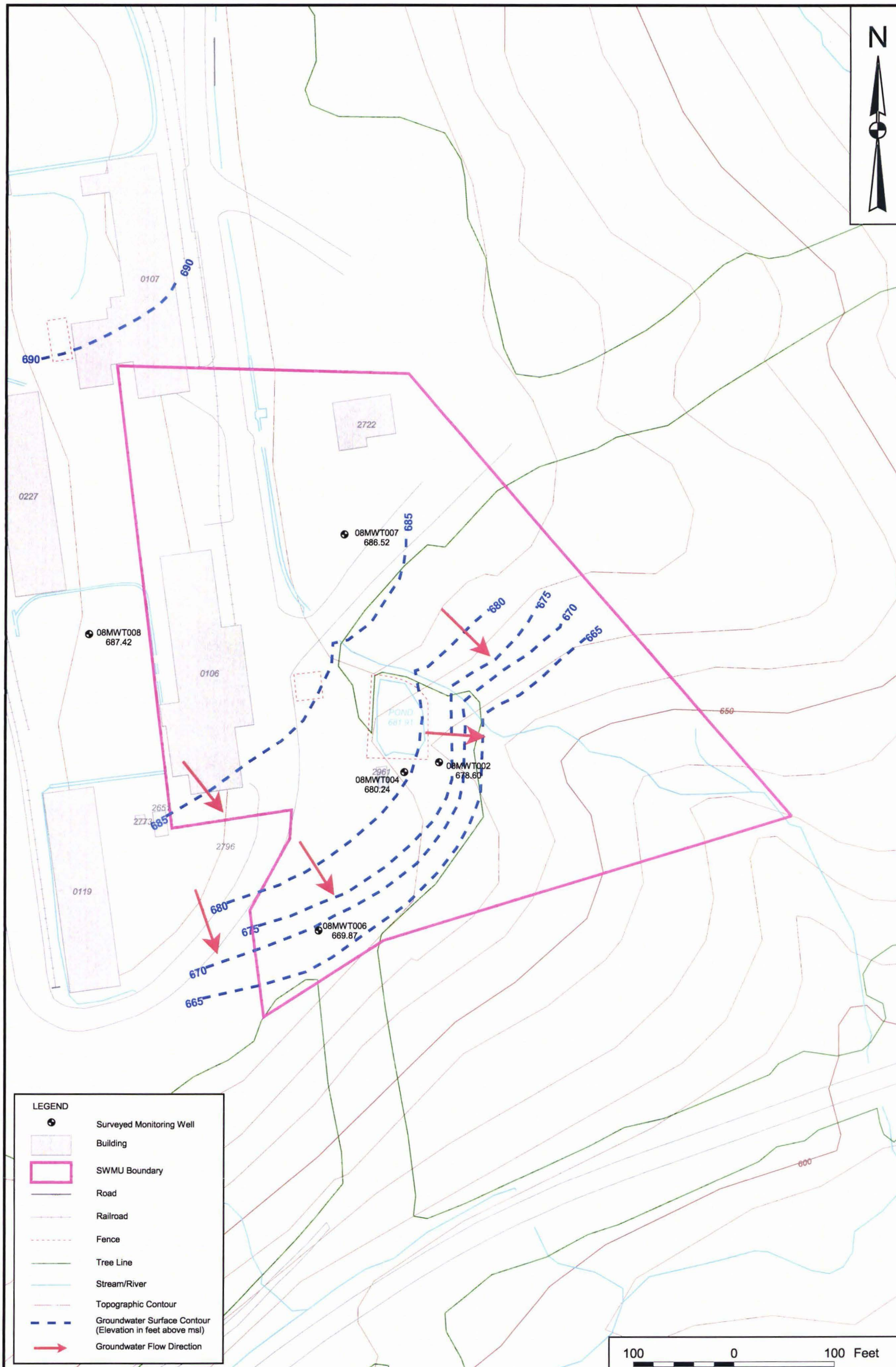

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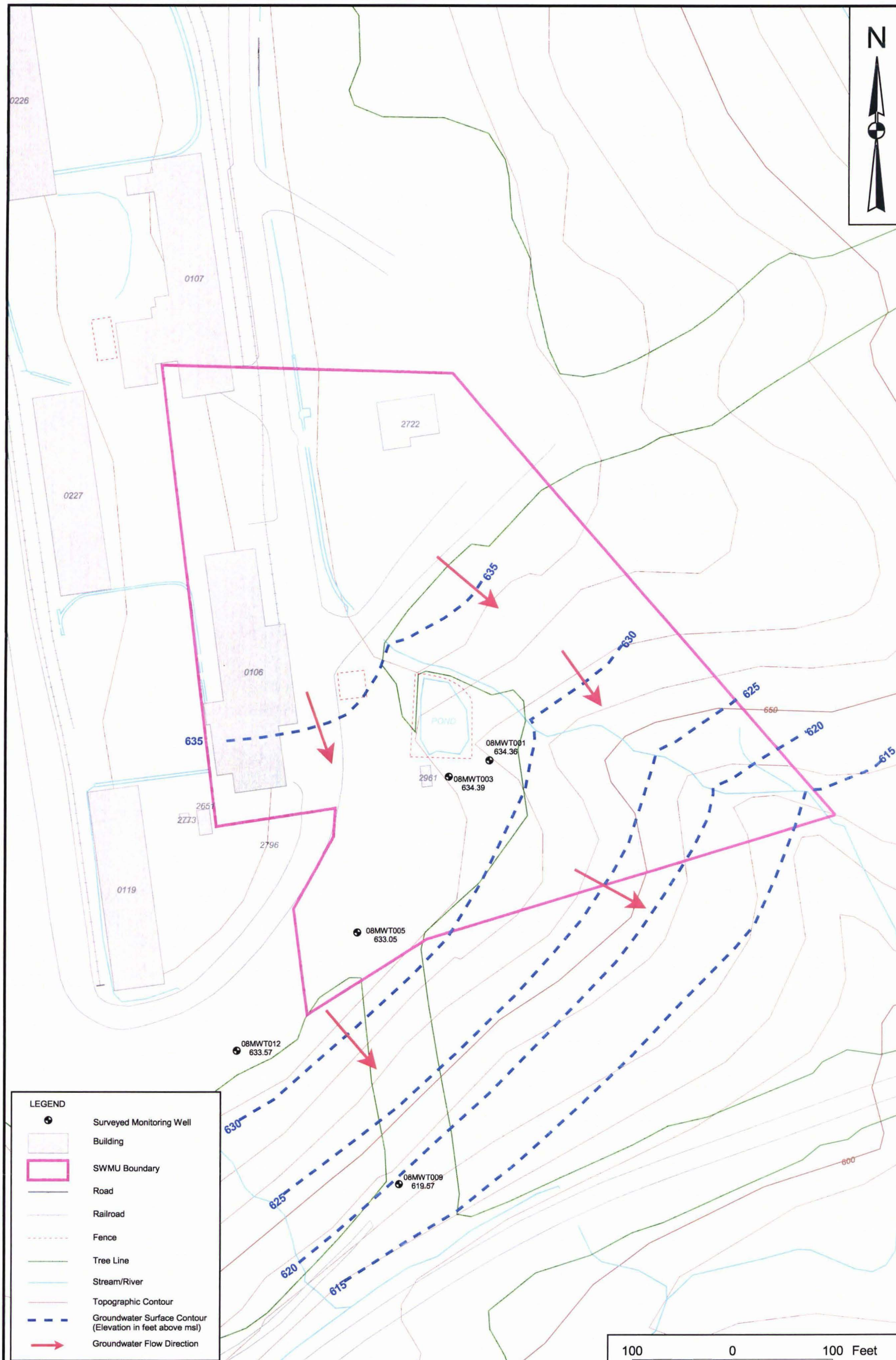

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K. TURNBULL	02/22/08
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

POTENTIOMETRIC SURFACE MAP FOR THE
MIDDLE PENNSYLVANIAN
WATER-BEARING ZONE - MARCH 1, 2006
SWMU 8 - BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

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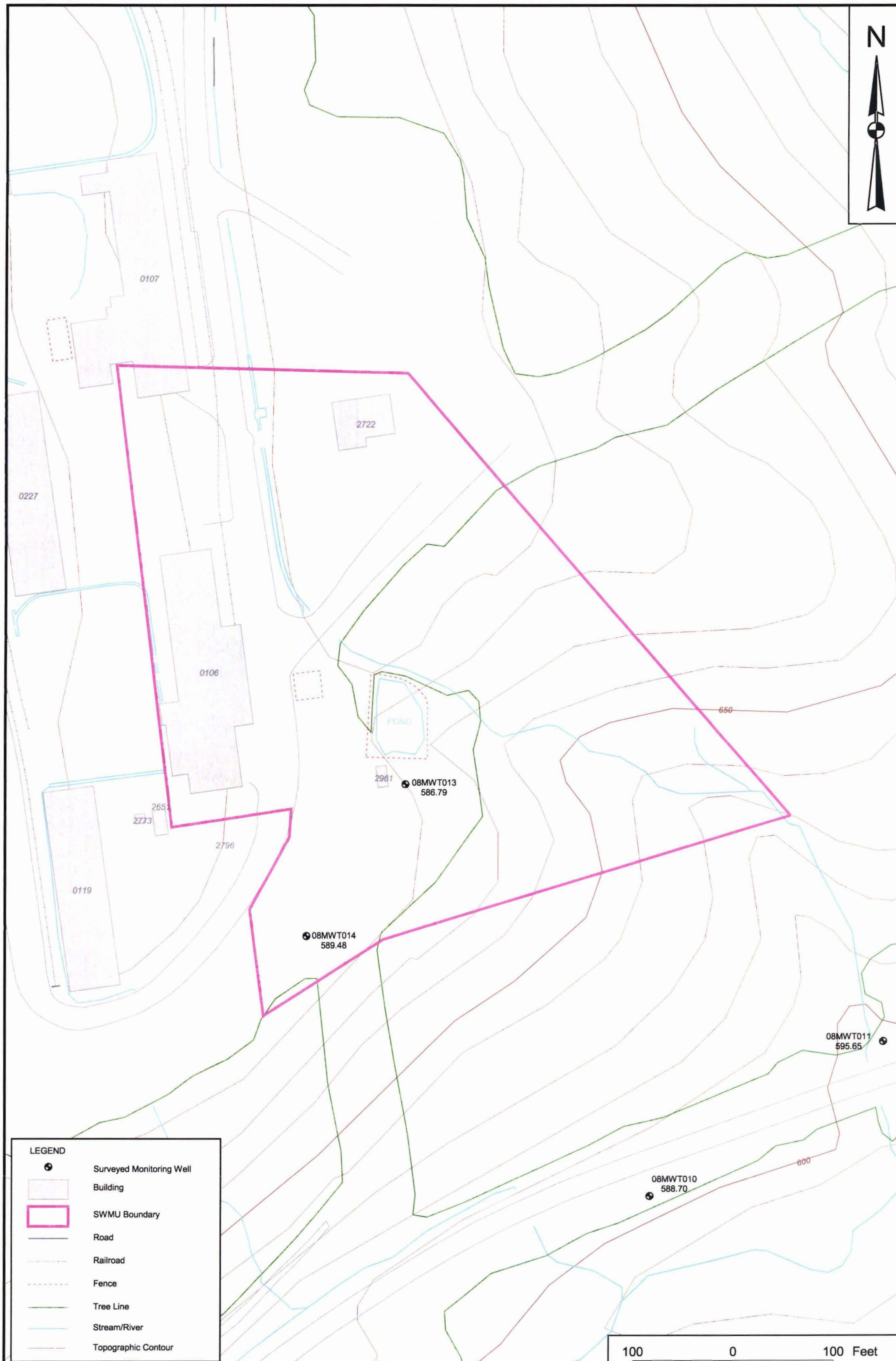

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K. TURNBULL	2/22/08
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

GROUNDWATER POTENTIOMETRIC ELEVATIONS
IN THE LOWER PENNSYLVANIAN
WATER-BEARING ZONE - MARCH 1, 2006
SWMU 8 - BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

CONTRACT NUMBER CTO 0021	
APPROVED BY —	DATE —
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2.0 DESCRIPTION OF CURRENT CONDITIONS AT SWMU 8 AND MEDIA CLEANUP STANDARDS

Various investigations and risk assessments have been conducted at SWMU 8. Section 2.1 describes the historical investigations that have resulted in identification of chemicals of potential concern (COPCs) and includes a summary of the nature and extent of contamination. Section 2.2 describes the conceptual site model for SWMU 8. Section 2.3 summarizes the results of the SWMU 8 human health risk assessment (HHRA) conducted during the RFI. Section 2.4 presents the MCSs.

Based on historical investigations, the only potential risks to ecological receptors were associated with the Building 106 Pond. Now that the pond has been remediated, there are no unacceptable risks to ecological receptors.

2.1 PREVIOUS INVESTIGATIONS

This section presents a summary of the current contamination conditions at SWMU 8 based on the RFI. Four rounds of sampling were conducted between December 2004 and October 2006 for the RFI. Additional details can be found in the RFI Report (Tetra Tech, 2008).

2.1.1 <u>Soil</u>

During the RFI, 65 boreholes were drilled. From these 65 boreholes, 44 surface soil samples were collected from 0 to 2 feet below ground surface (bgs), and 64 subsurface soil samples were collected from depths ranging from 2 to 18 feet bgs. Most soil samples were analyzed for volatile organic compounds (VOCs). Many of the samples were also analyzed for semivolatile organic compounds (SVOCs) [including polynuclear aromatic hydrocarbons (PAHs)], energetic compounds, perchlorate, and metals. A few samples were analyzed for pesticides, herbicides, and PCBs. Surface and subsurface soil samples were collected in the vicinity of the Building 106 Pond, grass and gravel areas around Buildings 106 and 107, and under Buildings 106 and 107 and surrounding pavement.

COPCs for surface soil for these areas based on comparisons of detected concentrations to human health and ecological risk-based screening criteria included PAHs and/or metals, as follows:

- Vicinity of Building 106 Pond – benzo(a)pyrene, aluminum, arsenic, iron, manganese, and vanadium.

- Grass and gravel areas around Buildings 106 and 107 – benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, aluminum, arsenic, iron, manganese, and vanadium.

- Under Building 106 and surrounding pavement – benzo(a)pyrene, dibenzo(a,h)anthracene, aluminum, arsenic, iron, and vanadium.

- Under Building 107 and surrounding pavement – none.

COPCs for subsurface soil for these areas based on comparisons of detected concentrations to risk-based screening criteria also included PAHs and/or metals, as follows:

- Vicinity of Building 106 Pond – benzo(a)pyrene, aluminum, antimony, arsenic, iron, manganese, and vanadium.

- Grass and gravel areas around Buildings 106 and 107 – aluminum, arsenic, iron, manganese, thallium, and vanadium.

- Under Building 106 and surrounding pavement – aluminum, arsenic, iron, and vanadium.

- Under Building 107 and surrounding pavement – none.

2.1.2 Groundwater

During the RFI, 14 permanent and 17 temporary monitoring wells were installed in the Puz, Pmz, and Plz. Some of the temporary monitoring wells were installed during Round 1, and the sampling results were used to locate permanent monitoring wells. Eleven of the permanent wells were installed and sampled as part of the Round 2 field work. Results from the Round 2 samples indicated that additional monitoring wells were required; therefore, Round 3 included the addition of three new permanent wells. Further analysis suggested there might be a source of contamination south of Building 106 that is not related to the pond. During Round 4, additional temporary wells were installed in this area and sampled. A total of 35 groundwater samples were collected from the permanent and temporary wells during Rounds 1 through 4. Samples collected from temporary wells during Round 1 were analyzed for VOCs, SVOCs, energetic compounds, perchlorate, and total and dissolved metals. Analyses were limited to VOCs, SVOCs, and total and dissolved metals in Round 2 and VOCs and SVOCs in Rounds 3 and 4.

COPCs for groundwater in the three water-bearing zones based on comparisons of detected concentrations to human health risk-based screening criteria included VOCs, SVOCs, and metals, as follows:

- Puz – 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, benzene, chloroethane, cis-1,2-dichloroethene, toluene, trans-1,2-dichloroethene, TCE, vinyl chloride, 1,4-dioxane, 3- and 4-methylphenol, aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, iron, lead, manganese, thallium, and vanadium.

- Pmz – 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, chloroform, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, vinyl chloride, 1,4-dioxane, aluminum, arsenic, cobalt, iron, manganese, and nickel.

- Plz – 1,4-dioxane, aluminum, arsenic, iron, manganese, and vanadium.

The concentrations of COPCs were greater in the Pmz than the Puz, which is an indication that the aquitard between these water-bearing units has been breached in one or more locations.

2.1.3 Surface Water and Seeps

A total of 32 surface water samples were collected from the Building 106 Pond and 16 other locations, including drainage ditches (tributaries) and the main stream, during Rounds 1 through 3 of the RFI. All samples were analyzed for VOCs, and many samples were also analyzed for SVOCs, PCBs, energetic compounds, perchlorate, and metals. Samples collected during Round 3 were only analyzed for VOCs because it became clear after two rounds of sampling that VOCs were the primary contaminants, and they had migrated farther than other contaminants.

COPCs for the various surface water types based on comparisons of detected concentrations to human health and ecological risk-based screening criteria included VOCs, SVOCs, and metals, as follows:

- Pond – 1,1-dichloroethane, 1,1-dichloroethene, 2-butanone, 4-methyl-2-pentanone, chloroethane, cis-1,2-dichloroethene, toluene, TCE, vinyl chloride, xylenes, 2-methylnaphthalene, aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, vanadium, and zinc.

- Tributaries – cis-1,2-dichloroethene, TCE, vinyl chloride, aluminum, arsenic, chromium, iron, lead, manganese, thallium, and vanadium.

- Main stream – aluminum, iron, and manganese.

2.1.4 Sediment

A total of 24 sediment samples were collected from the pond, drainage ditches, and main stream. These samples were analyzed primarily for VOCs, SVOCs, energetics, and perchlorate. During Round 1, four samples were analyzed for PCBs. During Round 2, many of the samples were also analyzed for metals.

COPCs for the various sediment types based on comparisons of detected concentrations to human health and ecological risk-based screening criteria included VOCs, PAHs, perchlorate, and metals, as follows:

- Pond – 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, chloroethane, cis-1,2-dichlorothene, trans-1,2-dichloroethene, TCE, benzo(a)pyrene, arsenic, iron, vanadium, and perchlorate.
- Tributaries – benzo(a)pyrene, aluminum, arsenic, iron, manganese, and vanadium.
- Main stream – aluminum, arsenic, iron, manganese, and vanadium.

2.1.5 Summary of Nature and Extent of Contamination

Based on the results and conclusions presented in the RFI Report (Tetra Tech, 2008) the degree and extent of contamination at SWMU 8 is rather limited and reasonably well bounded. The primary contaminants are chlorinated VOCs in pond sediment and pond water and chlorinated VOCs and 1,4-dioxane in groundwater. Figure 2-1 presents the concentrations of selected chlorinated VOCs and 1,4-dioxane detected in groundwater. Groundwater contaminant concentrations suggest that a source of VOC and 1,4-dioxane contamination other than the Building 106 Pond may exist in the area south of Building 106, but such a source was not found during the RFI.

The concentrations of several metals in groundwater were greater than human health screening values and upgradient concentrations, yet no link to SWMU 8 for the elevated metals was found. Slightly elevated concentrations of some metals were detected in the pond. However, the concentrations of metals in samples from the tributaries and main stream appear to reflect natural conditions, and metals do not appear to be significant site-related contaminants.

Available data indicate the surface water and sediment in tributary drainage channels is relatively contaminant free. Figure 2-1 presents the concentrations of selected chlorinated VOCs and 1,4-dioxane detected in surface water. Based on the results and conclusions presented in the RFI Report (Tetra Tech, 2008), the surface water and sediment in the pond were by far the most contaminated media at SWMU 8 and were determined to be the primary source of groundwater contamination. This was the reason that the interim remedial action for the pond was implemented.

2.2 CONCEPTUAL SITE MODEL

Past operations at SWMU 8 resulted in the release of chlorinated VOCs to the Building 106 Pond. Now that the interim remedial action for pond water and sediment is complete, the pond is no longer a source of contamination. Other potential sources of site-related groundwater contamination include building floor drains, drain lines from the buildings to the pond, and a former drum storage area located south of Building 106. Based on the distribution and types of contaminants found in the pond and groundwater, there is a strong likelihood that there have been releases of contaminants to the subsurface from areas other than the pond. Although surface and subsurface soil are slightly contaminated, it is not clear whether there are any vadose zone soils that could constitute an ongoing source of groundwater contamination. No additional sources were identified during the RFI.

The following is a summary of contaminant migration, fate, and persistence at SWMU 8 from the RFI Report (Tetra Tech, 2008):

- Chlorinated solvents, primarily TCE and 1,1,1-trichloroethane, have been released to the pond and groundwater.

- The Puz has been contaminated with chlorinated VOCs (primarily TCE, 1,1,1-trichloroethane, and their degradation products). Groundwater in this zone flows laterally toward the southern and southeastern slopes of the hillside. Much of the groundwater eventually reaches the edge of the hillside and is taken up by vegetation, discharges to the surface as seeps or springs, or continues down the slope as seepage through the thin veneer of soil that covers the hillside.

- Some groundwater in the Puz seeps vertically downward into the Pmz and then flows laterally to the south and southeast. The Pmz groundwater has been contaminated with the same chemicals as the Puz; however, contaminant concentrations are greater in the Pmz than the Puz. The Pmz groundwater intercepts the land surface along the lower portions of the hillside and is taken up by vegetation, discharges as seeps or springs, or migrates down the slope on the top of bedrock.

- Chlorinated solvents detected in groundwater (TCE and 1,1,1-trichloroethane) are degrading naturally. The detected concentrations of chloroethane, 1,1-dichloroethane, cis-1,2-dichloroethene, and vinyl chloride in Puz and Pmz groundwater near the pond are evidence that natural degradation is occurring.

- A very small portion of the Pmz groundwater migrates downward into the Plz. Although low concentrations of 1,1,1-trichloroethane and its degradation products have been detected at one location (08MWT014), chlorinated VOCs were not identified as COPCs for Plz groundwater. The siltstone and shale layers between the Pmz and Plz are an effective aquitard and prevent much of the shallow groundwater and contaminants in the Pmz from reaching the Plz. This deeper groundwater flows primarily toward the main stream located south of SWMU 8. However, the primary and secondary permeabilities of this water-bearing zone are less than the Puz and Pmz, and groundwater flow velocities are much slower in the deeper groundwater system.

- The main stream flowing past the southern side of SWMU 8 receives surface water and groundwater discharges and is the ultimate receptor of contaminants migrating from the SWMU. No site-related contaminants have been detected in main stream surface water. Very low concentrations of TCE and 1,1,1-trichloroethane were detected in sediment samples collected from two locations in the main stream. The data from the main stream indicate that virtually no contaminant mass is leaving SWMU 8 and migrating off site.

2.3 HUMAN HEALTH RISK ASSESSMENT SUMMARY

An HHRA was performed using data collected during the RFI to characterize the potential risks to likely human receptors under current and potential future land use. Potential receptors under current land use are maintenance workers, occupational workers, and adolescent trespassers. Additional potential receptors under future land use are construction workers, child and adult recreational users, and hypothetical child and adult residents. Although future land use is likely to be the same as current land use, the potential future receptors were evaluated primarily for decision-making purposes.

The HHRA concluded that there were no unacceptable carcinogenic or noncarcinogenic risks associated with exposure to soil, surface water, and sediment for any of the receptors. Although the risks calculated for exposure to Building 106 Pond surface water and sediment were acceptable, contamination from the pond, especially VOCs, has adversely affected groundwater; the reason for remediation of the pond.

The HHRA concluded that there were unacceptable potential carcinogenic and noncarcinogenic risks associated with exposure to shallow, intermediate, and deep groundwater for current occupational workers and future child recreational users and hypothetical residents.

The HHRA concluded that there were unacceptable cancer and non-cancer risks for future child and adult residents exposed to shallow (Puz) groundwater. The noncancer hazard index (HI) was greater than 1 for aluminum, arsenic, iron, manganese, and vanadium. The calculated risk may be biased high because high turbidity readings were reported for the sample (08MWT006) on which the risk was based. A filtered sample was collected at this location, and only manganese was detected at a concentration greater than the human health risk screening value. Aluminum, arsenic, iron, and vanadium were not detected in the filtered sample. Unacceptable cancer risks (i.e., greater than 1E-04) were identified for exposure to arsenic. The detected concentrations and associated cancer risk may be biased high because of elevated turbidity. Arsenic concentrations were greater than the National Primary Drinking Water Regulation Maximum Contaminant Level (MCL) of 10 micrograms per liter (μg/L) in samples from permanent wells 08MWT004 (10.3 μg/L) and 08MWT006 (26.4 μg/L). Arsenic was not detected in the filtered sample from 08MWT006. A filtered sample was not collected from 08MWT004. It should be noted that the metals that are risk drivers for shallow groundwater were not COCs for pond sediment, and the pond is not the suspected source of potential metals contamination. A source was not identified during the RFI. Although they did not result in unacceptable risks, the concentrations of the following chemicals were greater than their respective MCLs (provided in parentheses) at locations 08MWT002 and/or 08MWT006: 1,1-dichloroethene (7 μg/L), TCE (5 μg/L), and/or vinyl chloride (2 μg/L). The concentrations of COCs detected in shallow groundwater are provided in Table 2-1.

There were unacceptable noncancer risks for occupational workers, child recreational users, and future residents exposed to intermediate (Pmz) groundwater. The noncancer HIs for occupational workers and child recreational users were greater than 1 for manganese. The noncancer HIs for future residents were greater than 1 for 1,1-dichloroethene, TCE, iron, manganese, and nickel. Unacceptable cancer risks were identified for exposure to TCE for occupational workers and future residents. The concentrations of the following chemicals were greater than their respective MCLs at locations 08MWT001, 08MWT003, and/or 08MWT005: 1,1,1-trichloroethane (200 μg/L), 1,1,2-trichloroethane (5 μg/L), 1,1-dichloroethene (7 μg/L), cis-1,2-dichloroethene (70 μg/L), TCE (5 μg/L), and/or vinyl chloride (2 μg/L). The concentrations of COCs detected in intermediate groundwater are provided in Table 2-2.

The only unacceptable risks from exposure to deep (Plz) groundwater were for the future child resident. The noncancer HIs were greater than 1 for iron and manganese. No unacceptable cancer risks were identified, and there were no chemicals detected at concentrations greater than MCLs. The concentrations of COCs detected in deep groundwater are provided in Table 2-3.

Exposure to 1,4-dioxane does not pose any unacceptable risks; there is no MCL or IDEM default residential closure level for 1,4-dioxane. However, 1,4-dioxane was one of the five organic chemicals detected in samples from the Puz, Pmz, and Plz. 1,4-Dioxane was not detected in soil or pond sediment samples. The maximum concentration detected in pond water and tributary surface water samples was less than 6 μg/L. The maximum concentrations in the Puz (35 μg/L, Table 2-1), Pmz (150 μg/L, Table 2-2), and Plz (44 μg/L, Table 2-3) were greater than those detected in surface water. Therefore, it was determined that the pond is not the source of 1,4-dioxane detected in groundwater. A potential source was not identified during the RFI.

2.4 MEDIA CLEANUP STANDARDS

Groundwater is the only medium of concern at SWMU 8. There are no unacceptable risks to human health, ecological receptors, or the environment associated with soil, surface water, and sediment. Groundwater COCs were identified in the RFI based on an unacceptable risk or exceedance of an MCL. COCs identified, based on unacceptable carcinogenic or noncarcinogenic risks, are 1,1-dichloroethene, TCE, aluminum, arsenic, iron, manganese, nickel, and vanadium. COCs identified, based on MCL exceedances, are 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, TCE, vinyl chloride, and arsenic. The MCSs for each water-bearing zone (i.e., Puz, Pmz, and Plz) are provided in Table 2-4. MCSs are based on MCLs, IDEM default residential closure levels, or potential risks to the most sensitive receptors (i.e., child resident). Calculations for risk-based MCSs are provided in Appendix A. The locations where groundwater concentrations were greater than MCSs are summarized in Table 2-5.

TABLE 2-1

ANALYTICAL RESULTS FOR CHEMICALS OF INTEREST DETECTED IN SHALLOW BEDROCK AND OVERBURDEN GROUNDWATER
SWMU 8 - LOAD AND FILL AREA, BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA
PAGE 1 OF 2

Characterization Sampling Round Location Sample Number Sample Date	MCL	UPGRAD 02 08MWT007 08GWT00701 6/2/2005	UPGRAD 03 08MWT007 08GWT00702 10/15/2005	DOWNGRAD 02 08MWT002 08GWT00201 6/2/2005	DOWNGRAD 03 08MWT002 08GWT00202 10/11/2005	DOWNGRAD 02 08MWT004 08GWT00401 6/3/2005
Volatile Organics (µg/L)						
1,1-DICHLOROETHENE	7	0.3 U	0.3 U	4.2	0.3 U	0.3 U
TRICHLOROETHENE	5	0.3 U	0.3 U	**12**	1.6	0.3 U
VINYL CHLORIDE	2	0.3 U	0.3 U	**6.8**	0.3 U	1.5
Semivolatile Organics (µg/L)						
1,4-DIOXANE	NA	0.971 U	0.971 U	35	5	4 J
Total Metals (µg/L)						
ALUMINUM	NA	463 J		23.5 U		63.4 J
ARSENIC	10	0.45 U		0.34 U		**10.3 J**
IRON	NA	681 J		164 J		12500 J
MANGANESE	NA	93.9 J		636 J		2720 J
VANADIUM	NA	1.14 U		1.14 U		1.14 U
Dissolved Metals (µg/L)						
ARSENIC	10	0.15 U				
IRON	NA	6.15 UJ				
MANGANESE	NA	91.2 J				
VANADIUM	NA	1.14 U				

TABLE 2-1

ANALYTICAL RESULTS FOR CHEMICALS OF INTEREST DETECTED IN SHALLOW BEDROCK AND OVERBURDEN GROUNDWATER
SWMU 8 - LOAD AND FILL AREA, BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

Characterization Sampling Round Location Sample Number Sample Date	MCL	DOWNGRAD 03 08MWT004 08GWT00402 10/11/2005	DOWNGRAD 02 08MWT006 08GWT00601 6/3/2005	DOWNGRAD 03 08MWT006 08GWT00602 10/12/2005	DOWNGRAD 02 08MWT008 08GWT00801 6/4/2005	DOWNGRAD 03 08MWT008 08GWT00802 10/15/2005
Volatile Organics (ug/L)						
1,1-DICHLOROETHENE	7	0.3 U	3.8	29	0.3 U	0.3 U
TRICHLOROETHENE	5	0.3 U	1.8	19	1.6	0.7 J
VINYL CHLORIDE	2	0.3 U	0.3 U	1.4	0.3 U	0.3 U
Semivolatile Organics (ug/L)						
1,4-DIOXANE	NA	5	3 J	21	1.06 U	1.04 U
Total Metals (ug/L)						
ALUMINUM	NA		68200 J		33.8 U	
ARSENIC	10		26.4 J		0.46 U	
IRON	NA		45600		48.5 J	
MANGANESE	NA		1510		1410	
VANADIUM	NA		38.3		1.14 U	
Dissolved Metals (ug/L)						
ARSENIC	10		0.46 U			
IRON	NA		57.2			
MANGANESE	NA		894			
VANADIUM	NA		1.14 U			

µg/L - Micrograms per liter.
Black background indicates value that exceeds MCL.
Blank cells indicate that no data are available.
J - Estimated.
MCL - Maximum Contaminant Level (40 CFR 141).
NA - No MCL.
U - Not detected.
UJ - Not detected; estimated detection limit.

TABLE 2-2

ANALYTICAL RESULTS FOR CHEMICALS OF INTEREST DETECTED IN INTERMEDIATE ZONE GROUNDWATER
SWMU 8 - LOAD AND FILL AREA, BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

Characterization Sampling Round Location Sample Number Sample Date	MCL	DOWNGRAD 02 08MWT001 08GWT00101 6/2/2005	DOWNGRAD 03 08MWT001 08GWT00102 10/13/2005	DOWNGRAD 02 08MWT003 08GWT00301 6/2/2005	DOWNGRAD 03 08MWT003 08GWT00302 10/14/2005
Volatile Organics (µg/L)					
1,1,1-TRICHLOROETHANE	200	**580**	**1000**	**610**	**930**
1,1,2-TRICHLOROETHANE	5	**5.4**	3.7	2.4	3.2
1,1-DICHLOROETHENE	7	**370**	**630**	**550**	**800**
CIS-1,2-DICHLOROETHENE	70	**120**	**300**	**120**	**110**
TRICHLOROETHENE	5	**2300**	**8200**	**3700**	**4000**
VINYL CHLORIDE	2	**2.4**	**3.4**	**5**	**4.6**
Semivolatile Organics (µg/L)					
1,4-DIOXANE	NA	110	46	150	130
Total Metals (µg/L)					
IRON	NA	88 J		194 J	
MANGANESE	NA	178 J		260 J	
NICKEL	NA	15.3 J		20.8 J	

TABLE 2-2

ANALYTICAL RESULTS FOR CHEMICALS OF INTEREST DETECTED IN INTERMEDIATE ZONE GROUNDWATER
SWMU 8 - LOAD AND FILL AREA, BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

Characterization Sampling Round Location Sample Number Sample Date	MCL	DOWNGRAD 02 08MWT005 08GWT00501 6/3/2005	DOWNGRAD 03 08MWT005 08GWT00502 10/14/2005	DOWNGRAD 02 08MWT009 08GWT00901 6/3/2005	DOWNGRAD 03 08MWT009 08GWT00902 10/15/2005	DOWNGRAD 03 08MWT012 08GWT01201 10/17/2005
Volatile Organics (µg/L)						
1,1,1-TRICHLOROETHANE	200	2700	3900	16	36	7.5
1,1,2-TRICHLOROETHANE	5	9.9	9.2	0.3 U	0.3 U	0.3 U
1,1-DICHLOROETHENE	7	1700	2600	3.1	5.5	1.6
CIS-1,2-DICHLOROETHENE	70	8.1	9	0.3 U	0.3 U	0.3 U
TRICHLOROETHENE	5	1.9	2.5	0.3 U	0.3 U	0.3 U
VINYL CHLORIDE	2	2	3.3	0.3 U	0.3 U	0.3 U
Semivolatile Organics (µg/L)						
1,4-DIOXANE	NA	21	19	0.99 U	3 J	1 U
Total Metals (µg/L)						
IRON	NA	756 J		9510 J		
MANGANESE	NA	5330 J		10700 J		
NICKEL	NA	223 J		820 J		

µg/L - Micrograms per liter.
Black background indicates value that exceeds MCL.
Blank cells indicate no data are available.
J - Estimated.
MCL - Maximum Contaminant Level (40 CFR 141).
NA - No MCL.
U - Not detected.

TABLE 2-3

ANALYTICAL RESULTS FOR CHEMICALS OF INTEREST DETECTED IN DEEP ZONE GROUNDWATER
SWMU 8 - LOAD AND FILL AREA, BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

Characterization Sampling Round Location Sample Number Sample Date	MCL	DOWNGRAD 02 08MWT010 08GWT01001 6/3/2005	DOWNGRAD 03 08MWT010 08GWT01002 10/12/2005	DOWNGRAD 02 08MWT011 08GWT01101 6/4/2005	DOWNGRAD 03 08MWT011 08GWT01102 10/12/2005	DOWNGRAD 03 08MWT013 08GWT01301 10/16/2005	DOWNGRAD 03 08MWT014 08GWT01401 10/16/2005
Semivolatile Organics (µg/L)							
1,4-DIOXANE	NA	0.98 U	0.971 U	44	32	4.04 U	1.11 UJ
Total Metals (µg/L)							
IRON	NA	400		13400			
MANGANESE	NA	110		533			
Dissolved Metals (µg/L)							
IRON	NA			24.3 J			
MANGANESE	NA			370			

µg/L - Micrograms per liter.
Blank cell indicates that no data are available.
J - Estimated.
MCL - Maximum Contaminant Level (40 CFR 141).
NA - No MCL.
U - Not detected.
UJ - Not detected; estimated detection limit.

TABLE 2-4

MEDIA CLEANUP STANDARDS
SWMU 8 – LOAD AND FILL AREA, BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

COC	Puz	Pmz	Plz	Basis
Volatile Organics (μg/L)				
1,1,1-Trichloroethane	NA	200	NA	MCL
1,1,2-Trichloroethane	NA	5	NA	MCL
1,1-Dichloroethene	7	7	NA	MCL
cis-1,2-Dichloroethene	NA	70	NA	MCL
Trichloroethene	5	5	NA	MCL
Vinyl chloride	2	2	NA	MCL
Metals (μg/L)				
Aluminum	10,500	NA	NA	Risk
Arsenic	10	NA	NA	MCL
Iron	3,110	3,110	3,110	Risk
Manganese	243	243	243	Risk
Nickel	NA	730	NA	IDEM
Vanadium	9.8	NA	NA	Risk

μg/L Micrograms per liter.
COC Chemical of concern.
IDEM Indiana Department of Environmental Management Default Residential Closure Level (IDEM, 2006).
MCL Maximum Contaminant Level.
NA Not applicable; not a COC for this groundwater zone.
Plz Deep groundwater zone.
Pmz Intermediate groundwater zone.
Puz Shallow groundwater zone.
Risk Media cleanup standard was calculated based on site-specific risk. See Appendix A for calculations.

TABLE 2-5

SUMMARY OF EXCEEDANCES OF MEDIA CLEANUP STANDARDS
SWMU 8 – LOAD AND FILL AREA, BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

Location	Chemical of Concern	Concentration (µg/L) and Date	Comments
Shallow Zone (Puz)			
08MWT002	Trichloroethene	12 (6/05)	1.6 µg/L (<MCS) in 10/05.
	Vinyl chloride	6.8 (6/05)	Not detected in 10/05.
08MWT004	Arsenic	10.3 (6/05)	
	Iron	12,500 (6/05)	
	Manganese	2,720 (6/05)	
08MWT006	1,1-Dichoroethene	29 (10/05)	3.8 µg/L (<MCS) in 6/05.
	Trichloroethene	19 (10/05)	1.8 µg/L (<MCS) in 6/05.
	Aluminum	68,200 (6/05)	Not detected in filtered sample.
	Arsenic	26.4 (6/05)	Not detected in filtered sample.
	Iron	45,600 (6/05)	57.2 µg/L (<MCS) in filtered sample.
	Manganese	1,510 (6/05)	894 µg/L (>MCS) in filtered sample.
	Vanadium	38.3 (6/05)	Not detected in filtered sample.
08MWT008	Manganese	1,410 (6/05)	
Intermediate Zone (Pmz)			
08MWT001	1,1,1-Trichloroethane	580 (6/05); 1,000 (10/05)	
	1,1,2-Trichloroethane	5.4 (6/05)	3.7 µg/L (<MCS) in 10/05.
	1,1-Dichloroethene	370 (6/05); 630 (10/05)	
	cis-1,2-Dichloroethene	120 (6/05); 300 (10/05)	
	Trichloroethene	2,300 (6/05); 8,200 (10/05)	
	Vinyl chloride	2.4 (6/05); 3.4 (10/05)	
08MWT003	1,1,1-Trichloroethane	610 (6/05); 930 (10/05)	
	1,1-Dichloroethene	550 (6/05); 800 (10/05)	

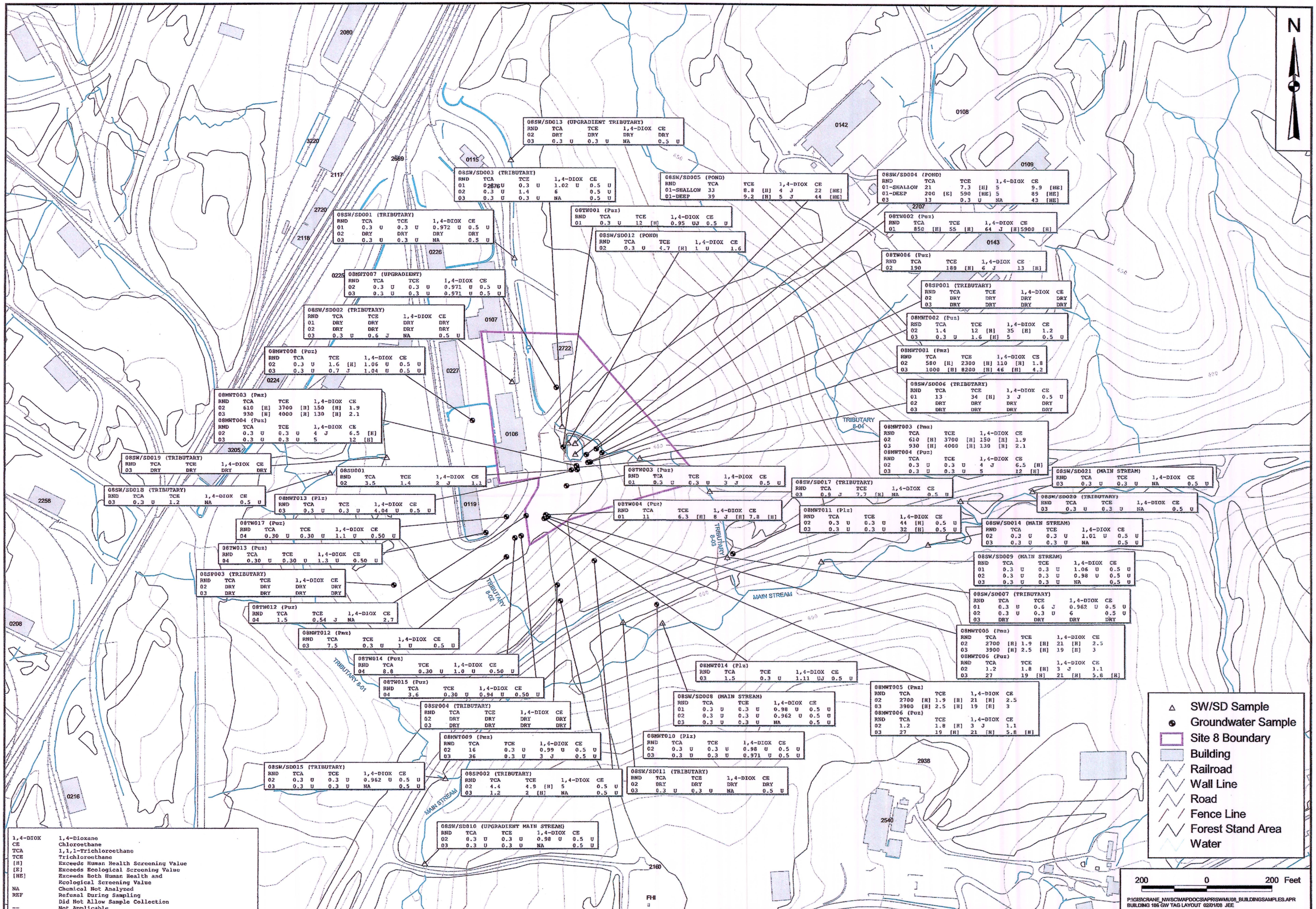
TABLE 2-5

SUMMARY OF EXCEEDANCES OF MEDIA CLEANUP STANDARDS
SWMU 8 – LOAD AND FILL AREA, BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

Location	Chemical of Concern	Concentration (µg/L) and Date	Comments
08MWT003 (cont.)	cis-1,2-Dichloroethene	120 (6/05); 110 (10/05)	
	Trichloroethene	3,700 (6/05); 4,000 (10/05)	
	Vinyl chloride	5 (6/05); 4.6 (10/05)	
	Manganese	260 (6/05)	
08MWT005	1,1,1-Trichloroethane	2,700 (6/05); 3,900 (10/05)	
	1,1,2-Trichloroethane	9.9 (6/05); 9.2 (10/05)	
	1,1-Dichloroethene	1,700 (6/05); 2,600 (10/05)	
	Vinyl chloride	3.3 (10/05)	2 µg/L (at MCS) in 6/05.
	Manganese	5,330 (6/05)	
08MWT009	Iron	9,510 (6/05)	
	Manganese	10,700 (6/05)	
	Nickel	820 (6/05)	
Deep Zone (Plz)			
08MWT011	Iron	13,400 (6/05)	24.3 µg/L (<MCS) in filtered sample.
	Manganese	533 (6/05)	370 µg/L (>MCS) in filtered sample.

Note: Samples collected in October 2005 were not analyzed for metals.

µg/L micrograms per liter.
MCS media cleanup standard.
Plz Lower Pennsylvanian water-bearing zone.
Pmz Middle Pennsylvanian water-bearing zone.
Puz Upper Pennsylvanian water-bearing zone.



1,4-DIOX	1,4-Dioxane
CE	Chloroethane
TCA	1,1,1-Trichloroethane
TCE	Trichloroethane
[H]	Exceeds Human Health Screening Value
[E]	Exceeds Ecological Screening Value
[HE]	Exceeds Both Human Health and Ecological Screening Value
NA	Chemical Not Analyzed
REF	Refusal During Sampling Did Not Allow Sample Collection
--	Not Applicable

Screening Values

Chemical	Human Health	Ecological (1)
CE	4.6	--
TCA	97	29800
TCE	2.8	12400

Concentrations and screening values are reported in ug/kg.
1 Subsurface samples were not screened against ecological criteria

DRAWN BY: K. MOORE	DATE: 3/19/07		
CHECKED BY: J. GOERDT	DATE: 3/23/07		
COST/SCHEDULE-AREA			
SCALE: AS NOTED			

NAVFAC

SELECT VOLATILE AND SEMIVOLATILE ORGANIC COMPOUND CONCENTRATIONS (ug/L) IN GROUNDWATER AND SURFACE WATER
SWMU 8 - BUILDING 106 POND
NWSC CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO 331
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 2-1	REV 0

3.0 REMEDIAL ACTION EVALUATION AT SWMU 8

This section summarizes the CMs considered for groundwater remedial action at SWMU 8. The following CMs were considered for shallow (Puz), intermediate (Pmz), and deep (Plz) groundwater based on the information provided in Section 2.0:

- Alternative 1 – No Action
- Alternative 2 – Limited Action

3.1 ALTERNATIVE 1 – NO ACTION

No action is required for Alternative 1. This alternative is used as a baseline for comparison with other alternatives.

3.2 ALTERNATIVE 2 – LIMITED ACTION

Alternative 2 includes natural attenuation, land use controls (LUCs), monitoring, and 5-year reviews. Data collected during the RFI indicate that the chlorinated VOCs detected in groundwater are naturally degrading. LUCs would be implemented to ensure that contaminated groundwater is not used as a source of drinking water until the MCSs are attained.

Monitoring would include annual sampling and analysis of groundwater. The objectives of monitoring would be to determine the effectiveness of natural attenuation, to confirm that contaminants are not migrating off site at unacceptable levels, and to determine when the MCSs have been attained and LUCs are no longer required.

Five-year site reviews would be conducted to verify the long-term reliability and effectiveness of this alternative and to provide direction for further remedial action, if deemed necessary. These reviews could also evaluate whether the risk estimates for exposure to metals in groundwater are biased high because of high turbidity in the samples on which the unacceptable risks were based.

4.0 CORRECTIVE MEASURES COMPARISON

The section evaluates the CMs presented in Section 3.0 and summarized in Table 4-1. The alternatives were evaluated using the following standards/criteria set forth in USEPA guidance on RCRA Corrective Action Plans (USEPA, 1994):

- Protection of human health and the environment.
- Attainment of MCSs.
- Control of the sources of releases.
- Compliance with any applicable standards for management of wastes.
- Other factors (long-term reliability and effectiveness, reduction in the toxicity, mobility, or volume of wastes, short-term effectiveness, implementability, and cost).

Two additional criteria will also be evaluated when the required information is available prior to the selection and implementation of a corrective action measure. These are regulatory and community acceptance of the proposed alternative, as follows:

- Regulatory acceptance: The Navy will respond to comments and resolve issues with IDEM and USEPA throughout the finalization of the CMP and other reports pertaining to the CMs selection and implementation process.

- Community acceptance: The Navy has established a Restoration Advisory Board (RAB) to provide updates to the community on the environmental activities at NSWC Crane. The RAB members are notified prior to RAB meetings, which is currently on an as-needed basis. A website has been established for the purpose of providing information on the current status of projects and remedial decisions (http://www.crane.navy.mil/newscommunity/Envir_RAB_default.asp). Reports on environmental activities are also maintained as part of the NSWC Crane Administrative Record, and access to the reports is available upon request to the NSWC Crane Environmental Department. The website and Administrative Record provide access to reports and will be used to obtain input from the local community on this CMP Report and other reports pertaining to the CMs selection and implementation process. The Statement of Basis, which will be generated following approval of this CMP Report, will be the official document of record in which the proposed corrective action is first made available to the public. The public will have the opportunity to comment on the Statement of Basis, and the comments will be considered when selecting the final remedial alternative for SWMU 8.

4.1 CORRECTIVE MEASURES ALTERNATIVES

4.1.1 Alternative 1 – No Action

4.1.1.1 Protection of Human Health and the Environment

Alternative 1 would not be protective of human health or the environment. There are no current users of groundwater; therefore, there are no unacceptable risks to current receptors. Alternative 1 would not prevent future use of groundwater in the Puz, Pmz, or Plz as a source of drinking water, which could result in unacceptable risks to human health in the future.

There is no current evidence that migration of groundwater contaminants to surrounding surface water has resulted in unacceptable risks to human health or ecological receptors. Alternative 1 does not include monitoring to determine whether continued contaminant migration could result in unacceptable risks in the future.

4.1.1.2 Attainment of Media Cleanup Standards

Alternative 1 would eventually attain MCSs for VOCs through natural attenuation, and it may attain MCSs for metals. However, this alternative does not include monitoring to verify that cleanup standards have been attained.

4.1.1.3 Source Control

An interim measure was implemented to remove contaminated pond water and pond sediment, which is the suspected primary source of groundwater contamination. Alternative 1 would not include any additional source control.

4.1.1.4 Compliance with Waste Management Standards

No actions would be implemented under Alternative 1; therefore, no waste would be generated.

4.1.1.5 Other Factors

Long-Term Reliability and Effectiveness

Alternative 1 would not be reliable and effective in the long term because no action would occur. Although groundwater contaminant concentrations would be expected to decrease as a result of natural attenuation processes, the effectiveness of this process would not be verified through monitoring. The potential threats to human health and the environment would remain because there would be no controls to prevent future groundwater use or monitoring to warn of potential contaminant migration.

Reduction in Toxicity, Mobility, and Volume

Alternative 1 would not reduce contaminant mobility. The toxicity and volume of groundwater contaminated with VOCs, and possibly metals, would be reduced through natural attenuation, but this would not be verified through monitoring.

Short-Term Effectiveness

Alternative 1 would involve no action and therefore would not pose any risks to on-site workers, the surrounding community, or the environment during remedy implementation.

Implementability

Because no action would occur, Alternative 1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable.

Cost

There are no costs associated with the no-action alternative.

4.1.2 Alternative 2 – Limited Action

4.1.2.1 Protection of Human Health and the Environment

Alternative 2 would be protective of human health and the environment. Natural attenuation would protect human health by reducing the concentrations of VOCs and possibly metals. The calculated risk from exposure to metals in groundwater may be biased high because high turbidity readings were reported for the some of the samples on which the risks were based. LUCs would protect human health by preventing exposure to contaminated groundwater in the Puz, Pmz, and Plz as long as contaminant concentrations are greater than MCSs. Monitoring would protect human health and the environment by determining whether the concentrations of metals used in the HHRA were biased high and actually pose a potential risk, by verifying the progress of groundwater remediation, and by warning of potential contaminant migration.

4.1.2.2 Attainment of Media Cleanup Standards

Alternative 2 would eventually attain MCSs for VOCs through natural attenuation, and it may attain MCSs for metals. Current site information does not allow an accurate prediction of the time required for natural attenuation to attain MCSs.

4.1.2.3 Source Control

An interim measure was implemented to remove contaminated pond water and pond sediment, which is the suspected primary source of groundwater contamination. Alternative 2 would not include any additional source control.

4.1.2.4 Compliance with Waste Management Standards

Alternative 2 would not involve any removal or ex-situ treatment of contaminated groundwater. Periodic sampling activities would generate some waste (e.g., purge water) that would have to be properly disposed. The volume of waste would be very small, and waste management regulations would be easily met.

4.1.2.5 Other Factors

<u>Long-Term Reliability and Effectiveness</u>

Alternative 2 would be effective and reliable in the long term. Natural attenuation would be expected to reduce the concentrations of VOCs and possibly metals. LUCs would reliably and effectively prevent potential exposure to contaminated groundwater. Monitoring would reliably and effectively determine whether the concentrations of metals used in the HHRA were biased high and actually pose a potential risk, to verify the long-term effectiveness of natural attenuation, to warn of potential contaminant migration, and to trigger consideration of another more active alternative if this alternative does not perform as expected.

Reduction in Toxicity, Mobility, and Volume

Alternative 2 would not reduce contaminant mobility. The toxicity and volume of groundwater contaminated with VOCs, and possibly metals, would be reduced through natural attenuation.

Short-Term Effectiveness

Alternative 2 would involve administration of LUCs and implementation of long-term monitoring. The short-term human health risks associated with these limited remedial activities would be minimal. Sampling personnel would undergo site-specific health and safety training and wear personal protective equipment to minimize potential risks. Implementation of this alternative would not result in any short-term threat to the surrounding community or the environment.

Implementability

Alternative 2 would be readily implementable. LUCs would be readily implementable because SWMU 8 is completely contained within NSWC Crane and would be similar to current LUCs at other environmental sites within NSWC Crane. Monitoring would also be readily implementable and would be similar to monitoring that is ongoing at several other environmental sites within NSWC Crane.

Alternative 2 could be implemented within approximately 12 months. Current site information does not allow the accurate prediction of the time required for natural attenuation to attain MCSs.

Cost

The following costs are estimated for Alternative 2:

- Capital cost: $2,000
- Annual Costs: $21,000 per year plus $15,000 every 5 years
- 30-Year NPW: $294,000

The above costs have been rounded to the nearest $1,000 to reflect the preliminary nature of these estimates. Detailed cost estimates are provided in Appendix B.

4.2 SWMU 8 CMP CONCLUSIONS

The following section summarizes the conclusions of the CMP for SWMU 8. These recommendations are based on the conceptual site model and HHRA presented in Sections 2.2 and 2.3, respectively.

The following recommendations are made for groundwater:

- Screening and detailed evaluations of alternatives to address unacceptable risks from ingestion of groundwater is not necessary because there are no current receptors and all future exposure to groundwater can be prevented by LUCs. The potential for contaminant migration can be evaluated by implementation of a long-term monitoring program.

- Alternative 2 is the recommended alternative. LUCs should be designed to prevent use of groundwater in the Puz, Pmz, and Plz water-bearing zones. The long-term monitoring program should be designed to provide information as to whether VOC and metals concentrations are degrading naturally. The long-term monitoring program should also be designed to determine whether the metals concentrations used to calculate the unacceptable risks are indicative of actual site conditions. Some of the concentrations of metals detected in groundwater samples during the RFI may have been biased high because of high turbidity readings.

TABLE 4-1

REMEDY EVALUATION PROCESS SUMMARY
SWMU 8 – LOAD AND FILL AREA, BUILDING 106 POND
NSWC CRANE
CRANE, INDIANA

MEDIUM	INVESTIGATION STAGE			REMEDIAL ACTION EVALUATION PHASE		
	Document	Findings/Evaluations	Conclusions	Considerations	Evaluation/Conclusions	Remedy
Soil	RFI Report	• No unacceptable risks to human health, ecological receptors, or the environment.	• No further action.	• No evaluation necessary.	• None required.	• No further action.
Pond Water and Pond Sediment	RFI Report	• No unacceptable risks to human health. • Potential unacceptable risks to ecological receptors. • Ongoing source of VOC groundwater contamination. • Not likely source of metals and 1,4-dioxane in groundwater.	• Proceed to CMS or conduct interim remedial action.	• Implemented interim measures (removal and off-site disposal).	• Interim measures eliminated suspected primary source of groundwater contamination (pond water and pond sediment). Monitoring needed to confirm effectiveness.	• No further action for pond. Conduct monitoring under groundwater remedy.
Groundwater	RFI Report	• Potential unacceptable risks for occupational workers, child recreational users, and hypothetical residents from exposure to VOCs and metals. • Some VOCs and arsenic detected at concentrations greater than MCLs. • Potential source of metals and 1,4-dioxane not found.	• Proceed to CMS.	• Groundwater not used. • Groundwater contaminants not migrating to surface water at unacceptable concentrations. • Groundwater contaminants not migrating off site. • Risks from exposure to some metals may be biased high because of excess turbidity in some samples.	• No unacceptable risks to current receptors were identified. • No action and limited action (land use controls and monitoring) only remedial actions evaluated.	• Land use controls to prevent use of groundwater. • Monitoring to evaluate effectiveness of interim measures for pond, evaluate effectiveness of natural attenuation of groundwater contaminants, and refine risks from metals. • Monitoring may help to identify source of metals and 1,4-dioxane.
Surface Water	RFI Report	• No unacceptable risks to human health, ecological receptors, or the environment.	• No further action.	• No evaluation necessary.	• None required.	• No further action.
Sediment	RFI Report	• No unacceptable risks to human health, ecological receptors, or the environment.	• No further action.	• No evaluation necessary.	• None required.	• No further action.

CMS Corrective Measures Study.
MCLs Maximum Contaminant Levels.
RCRA Resource Conservation and Recovery Act.
RFI RCRA Facility Investigation.
SWMU Solid Waste Management Unit.
VOCs Volatile organic compounds.

REFERENCES

IDEM (Indiana Department of Environmental Management), 2006. Risk Integrated System of Closure Technical Resource Guidance Document, February 2001, Updated January 2006.

Tetra Tech, 2008. Resource Conservation and Recovery Act Facility Investigation Report for Building 106 Pond (SWMU 8), Naval Surface Warfare Center Crane, Crane, Indiana. Prepared for Naval Facilities Engineering Command, Southern Division, North Charleston, South Carolina. Pittsburgh, Pennsylvania.

USEPA (United States Environmental Protection Agency), 1994. RCRA Corrective Action Plan (Final). Office of Waste Programs Enforcement, Office of Solid Waste, OSWER Directive 9902.3-2A. Washington, D.C.

APPENDIX A

DEVELOPMENT OF MEDIA CLEANUP STANDARDS

DEVELOPMENT OF MEDIA CLEANUP STANDARDS

The media cleanup standards (MCSs) for volatile organic chemicals of concern (COCs) and arsenic are based on the Primary Drinking Water Standard Maximum Contaminant Level (MCL). The MCS for nickel is based on the Indiana Department of Environmental Management (IDEM) Risk Integration System of Closure (RISC) default residential closure level. MCLs and IDEM residential closure levels are not available for aluminum, iron, manganese, and vanadium. The MCSs for these metals were calculated based on the risk to a future child resident, the most sensitive receptor, using the following equation:

$$MCS = \frac{EPC \times MCS\ HI}{EPC\ \ HI}$$

Where:

MCS = Media cleanup standard
EPC = Exposure point concentration (from RFI Report)
MCS HI = Hazard index for MCS (target is 1.0)
EPC HI = Hazard index for EPC (from RFI Report)

The MCSs for COCs in the shallow groundwater zone (Puz) that do not have an MCL or IDEM residential closure level are as follows:

Puz COC	EPC (μg/L)	MCS HI	EPC HI	MCS (μg/L)
Aluminum	68,200	1.0	6.5	10,492
Iron	45,600	1.0	15	3,040
Manganese	1,510	1.0	6.2	244
Vanadium	38.3	1.0	3.9	9.8

The MCSs for COCs in the intermediate groundwater zone (Pmz) that do not have an MCL or IDEM residential closure level are as follows:

Pmz COC	EPC (μg/L)	MCS HI	EPC HI	MCS (μg/L)
Iron	9,510	1.0	3.0	3,170
Manganese	10,700	1.0	44	243

The MCSs for COCs in the deep groundwater zone (Plz) that do not have an MCL or IDEM residential closure level are as follows:

Plz COC	EPC (µg/L)	MCS HI	EPC HI	MCS (µg/L)
Iron	13,400	1.0	4.3	3,116
Manganese	533	1.0	2.2	242

Note that the MCSs for iron and manganese for the shallow, intermediate, and deep groundwater zones are not exactly the same because the EPC HI was rounded to two significant figures. Therefore, the average value from the three groundwater zones will be used as the MCS, rounded to three significant figures (the same as for the EPC).

The MCSs for COCs that do not have an MCL or IDEM residential closure level are as follows:

- Aluminum = 10,500 µg/L
- Iron = (3,040 + 3,170 + 3,116)/3 = 3,110 µg/L
- Manganese = (244 + 243 + 242)/3 = 243 µg/L
- Vanadium = 9.8 µg/L

APPENDIX B

COST ESTIMATE

SWMU 8 - Building 106 Pond
Alternative 2: Limited Action (Land Use Controls and Monitoring
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents	40	hr			$35.00		$0	$0	$1,400	$0	$1,400
Subtotal							$0	$0	$1,400	$0	$1,400
Local Area Adjustments							100.0%	102.8%	89.7%	89.7%	
							$0	$0	$1,256	$0	$1,256
Overhead on Labor Cost @ 30%									$377		$377
G & A on Labor Cost @ 10%									$126		$126
G & A on Material Cost @ 10%								$0			$0
G & A on Subcontract Cost @ 10%							$0				$0
Total Direct Cost							$0	$0	$1,758	$0	$1,758
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$176
Subtotal											$1,934
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$1,934
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Cost @ 0%											$0
TOTAL COST											**$1,934**

Item	Item Cost Year 1 - 30	Item Cost every 5 years	Notes
Sampling and Site Inspection	$6,422		Labor, field supplies, and per diem for 2 people/4 days
Analysis/Water	$4,500		Analyze 12 groundwater samples for VOCs, 1,4-dioxane, and metals including blanks and duplicates.
Report	$10,000		Document sampling events and results
Site Review		$15,000	Five Year Site Reviews
TOTALS	$20,922	$15,000	

(1) Sampling rounds would occur annually for years 1 through 30.

NAVAL SURFACE WARFARE CENTER CRANE
Crane, Indiana
SWMU 8 - Building 106 Pond
Alternative 2: Limited Action (Land Use Controls and Monitoring)
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$1,934		$1,934	1.000	$1,934
1		$20,922	$20,922	0.935	$19,562
2		$20,922	$20,922	0.873	$18,265
3		$20,922	$20,922	0.816	$17,072
4		$20,922	$20,922	0.763	$15,963
5		$35,922	$35,922	0.713	$25,612
6		$20,922	$20,922	0.666	$13,934
7		$20,922	$20,922	0.623	$13,034
8		$20,922	$20,922	0.582	$12,177
9		$20,922	$20,922	0.544	$11,382
10		$35,922	$35,922	0.508	$18,248
11		$20,922	$20,922	0.475	$9,938
12		$20,922	$20,922	0.444	$9,289
13		$20,922	$20,922	0.415	$8,683
14		$20,922	$20,922	0.388	$8,118
15		$35,922	$35,922	0.362	$13,004
16		$20,922	$20,922	0.339	$7,093
17		$20,922	$20,922	0.317	$6,632
18		$20,922	$20,922	0.296	$6,193
19		$20,922	$20,922	0.277	$5,795
20		$35,922	$35,922	0.258	$9,268
21		$20,922	$20,922	0.242	$5,063
22		$20,922	$20,922	0.226	$4,728
23		$20,922	$20,922	0.211	$4,415
24		$20,922	$20,922	0.197	$4,122
25		$35,922	$35,922	0.184	$6,610
26		$20,922	$20,922	0.172	$3,599
27		$20,922	$20,922	0.161	$3,368
28		$20,922	$20,922	0.150	$3,138
29		$20,922	$20,922	0.141	$2,950
30		$35,922	$35,922	0.131	$4,706
				TOTAL PRESENT WORTH	**$293,895**